EN

Competence in Solids

SWR engineering

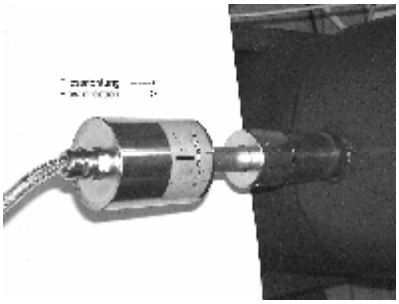
SolidFlow

Monitoring of Solids

Operating Instructions

SWR engineering Messtechnik GmbH

System Overview



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Sensor

Evaluation unit

1 Function

- SolidFlow is a measuring system especially developed for measuring the flow rate of conveyed solids in metallic ducts.
- The microwave energy is being reflected by the solid particles and received by the sensor. These signals are evaluated in frequency and amplitude.
- Because of the selective frequency evaluation only moving particles are measured.
- The measuring signal is independent of pressure and temperature in the duct. A measuring unit consists of one sensor and the evaluation unit.

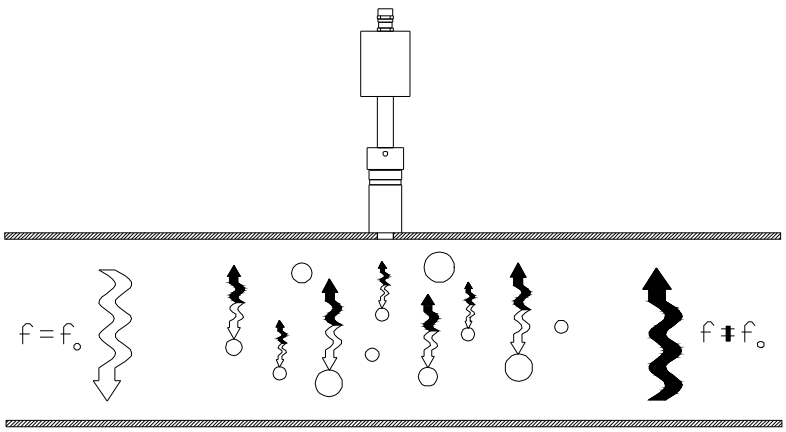


Fig. 3: Coupling and reflection of the microwaves.

2 Safety

The measuring system SolidFlow was designed, built and tested to be safe and was shipped in safe condition. Nevertheless persons or objects may be endangered by components of the system if these are operated in an inexpert manner. Therefore the operational instructions must be read completely and the safety notes must be followed.
In case of inexpert or irregular use, the manufacturer will refuse any liability or guarantee.

2.1 Regular use

- The measuring system must be installed for measuring the flow rate in metallic ducts only. Other usage and modifications of the measuring system are not permitted.
- Only original spare parts and accessories of SWR engineering must be used.

2.2 Identification of dangers

Possible dangers when using the measuring system are marked by the following symbols in the operating instructions:

Warning!

- This symbol in the operating instructions marks actions, which may represent a danger for life and limb of persons when carried out in an inexpert manner.

Attention!

- All actions which may endanger objects are marked with this symbol in the operating instructions.

2.3 Operational Safety

- The measuring system must be installed by trained and authorised personnel only.
- Switch off the supply voltage for all maintenance, cleaning or inspection works on the tubes or on components of the SolidFlow. Follow the notes of the chapter maintenance.
- Before hot-work the sensor must be removed from the piping.
- The components and electrical connections must be checked for damages regularly. If a damage is found, it is to be repaired before further operation of the instruments.

2.4 Technical Progress

The manufacturer reserves the right to adapt technical data to the technical progress without particular advance notice. If you have any questions, SWR engineering will be pleased to inform you on possible changes and extensions of the operating instructions.

3 Mounting and Installation

3.1 Delivery range

- Evaluation unit in the housing
- Weld on sensor accommodation
- Sensor, (union nut, distance washers, seal-ring for adjustment)
- Operating instructions

3.2 Auxiliary

- Drill Ø 20 mm for steel.
- 32 mm wrench for union nut
- Pliers for circlips (Ø 20 mm) for adjusting the wall thickness at the sensor

3.3 Mounting of the sensor

- The sensor is to be mounted as follows:
- Determine the place of mounting on the duct. On horizontal or inclined ducts the sensor should be mounted from top.
- In case of duct diameters greater than Ø 200 mm or a special application one has to install up to three sensors which are located 120 mm apart from each other and moved by 120° towards each other.
- The distances are valid for the vertical and horizontal installation position.
- Follow the necessary distances of valves, bows, fans or cellular wheel sluices etc. and also other measurement devices like temperature and pressure etc. to the sensor (see fig. 4).

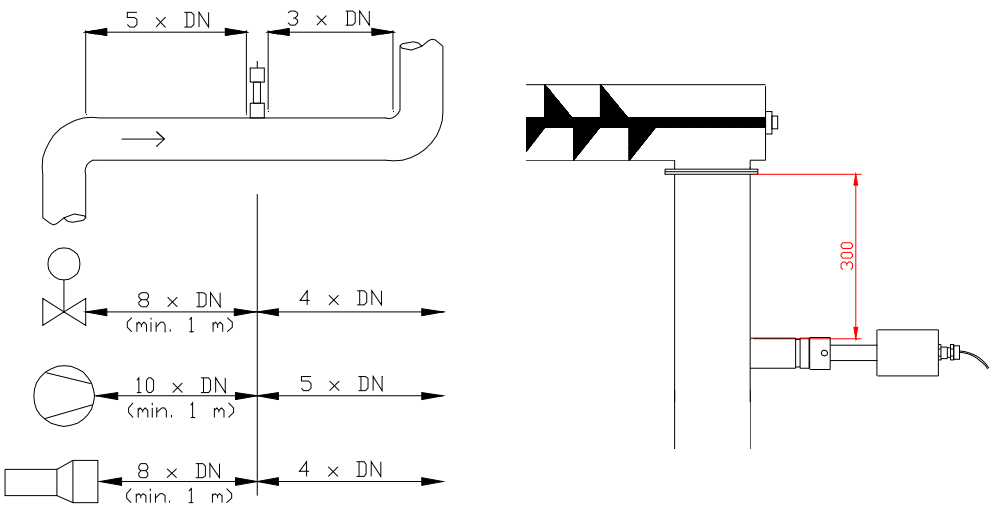


Fig. 4: Minimal distances of the sensor to duct bends and baffles.

- With free fall applications (e. g. after screw feeders or rotary valves) a free fall height of at least 300 mm would be perfect

- Weld the sensor accommodation on to the duct.
- Drill the Ø 20 mm hole into the duct. Please use your own drill as there are different shafts available. Take care that the hole is in line and rectangular to the surface to avoid trouble by inserting the sensor.

WARNING !

- After drilling you have to check, if there is a burr resulted at the drilling walls from the drilling. If so, this burr in the duct must be removed with an appropriate tool. If this burr is not removed, a calibration of the sensor is not possible.

- If the sensor is not installed immediately, the dummy plug must be put in until the sensor will be installed (see fig. 5). Use a 32 mm wrench for tightening the union nut.

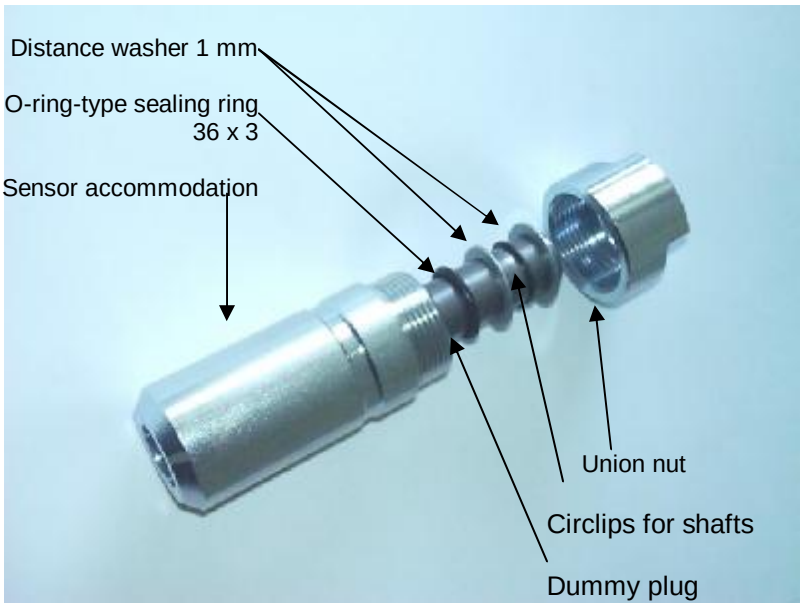


Fig. 5: Installation of the sensor accommodation and the dummy plug.

- Fig. 5: Installation of the sensor accommodation and the dummy plug.
- It is important that the sensor does not intrude into the duct because otherwise the front end of the sensor will be worn by abrasion. If necessary the wall thickness must be checked with a depth gauge. Then position the circlip in the complying slot. The sensor may be submerged into the duct wall by up to 1 mm without creating an error of measurement.

Wall thickness [mm]	***Circlip for shafts position***	***Number of distance washers.***
3.0	1	2
4.0	1	1
5.5	2	2
6.5	2	1
8.0	3	2
9.0	3	1
10.5	4	2
11.5	4	1
13.0	5	2
14.0	5	1

- Now the sensor is put into the sensor accommodation and screwed with the union nut according to figure 6a.

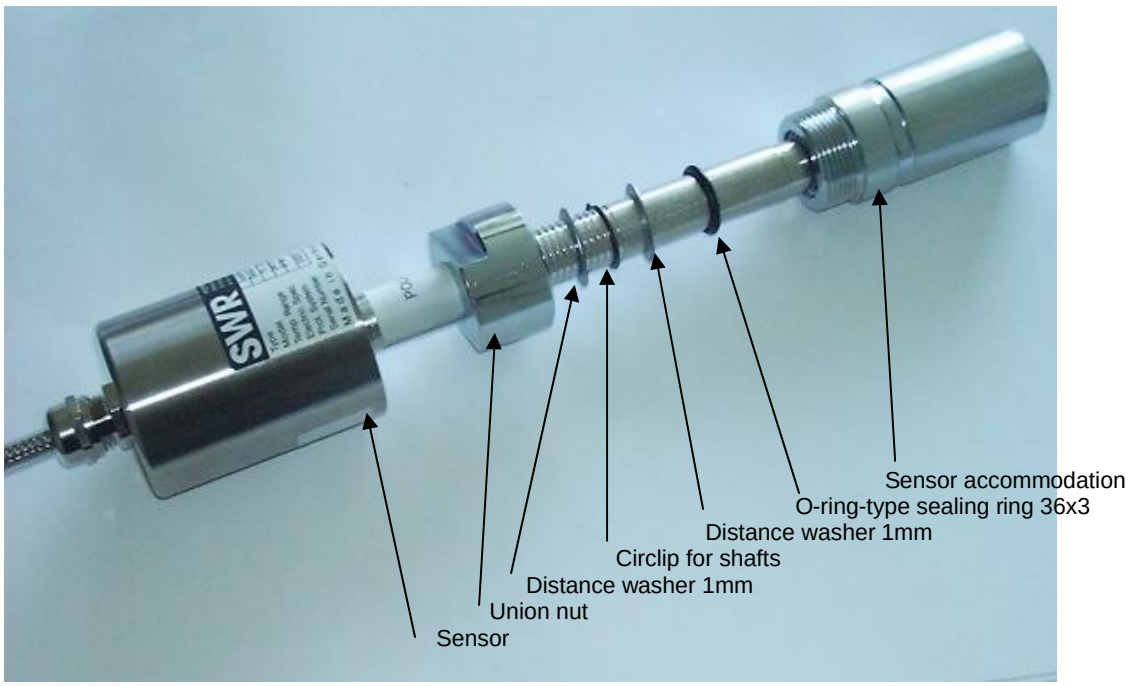


Fig. 6a: Installation of sensor accommodation and sensor.

- Look at the POLARISATION – label to adjust the sensor along to the duct, fig. 6b. Lock the sensor with the union nut dust proof and fix the sensor.

Fig. 6b: Polarisation of sensor

3.4 Mounting of the DIN rail transmitter unit

The whole electronic equipment can be installed at a maximum distance of 1 km from the sensor. The housing is prepared mounting in a DIN rail rack according to EN60715 TH35.

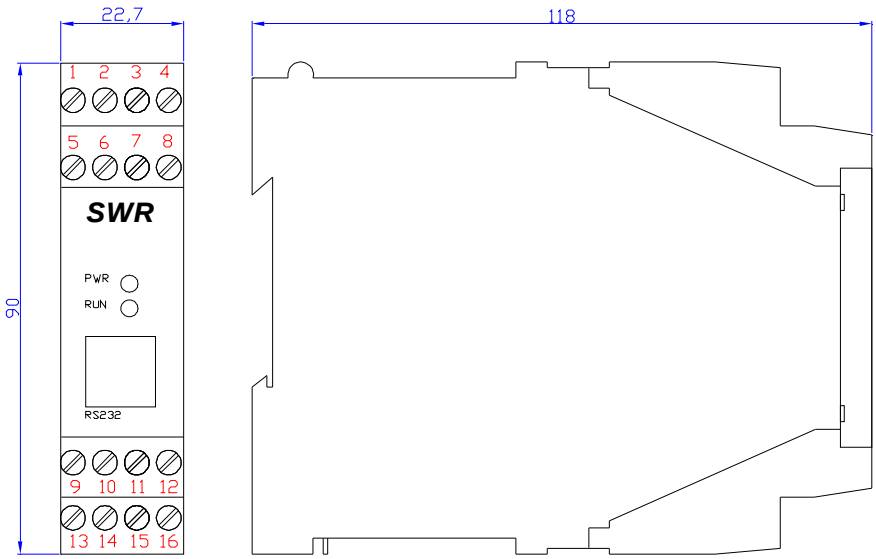


Fig. 7: Field housing evaluation unit

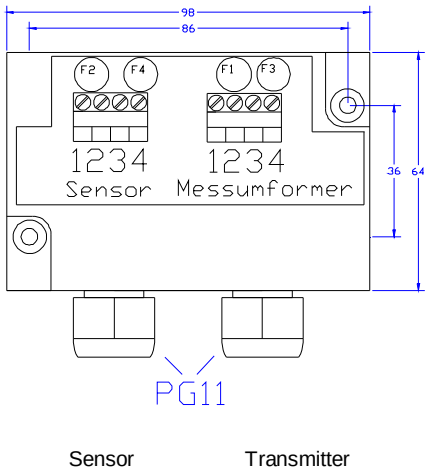


Fig. 8. Field housing of C-box

3.5 Overview of the optional use of the C-box

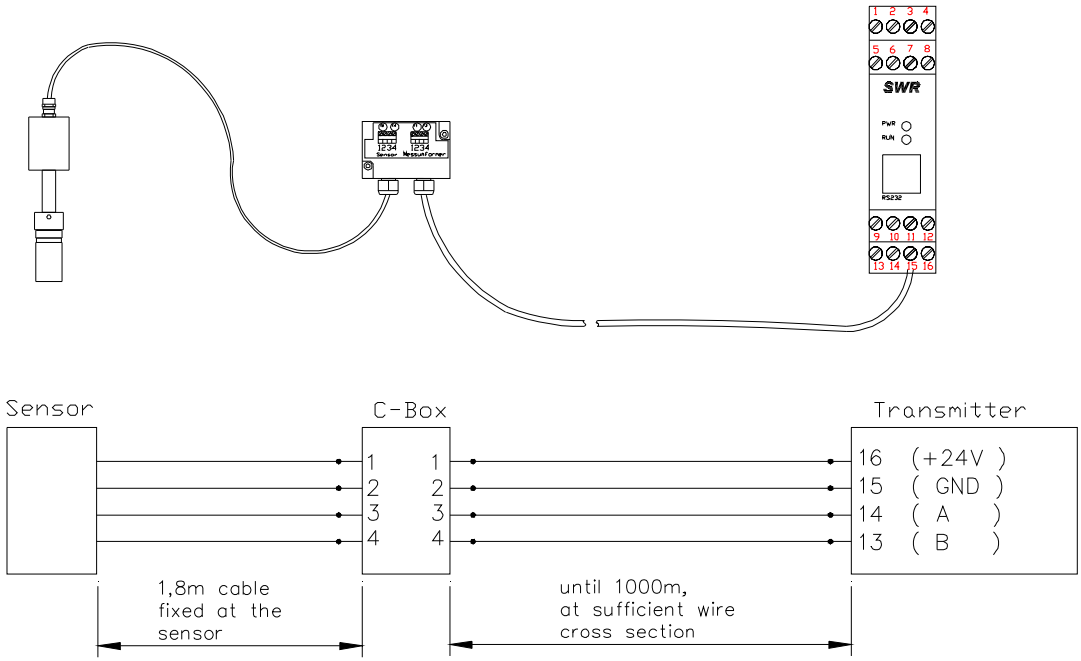


Fig 9 Overview of the optional use of the C-box

The C-box is an useful optional extension, if the distance between the sensor and the evaluation unit exceeds the given standard length of 1.8 meters. The C-box contains additional safety devices and terminal resistors to guarantee the communication over the modbus between the sensor and the evaluation unit even over longer distances. The necessary cable diameter for the cable connection between C-box and DIN rail unit are to be taken from the following table.

Cable length	Cable diameter
Up to 80m	0,75mm²
Up to 110m	1,00mm²
Up to 170m	1,50mm²
Up to 260m	2,50mm²
Up to 900m	4,00mm²

3.6 Use in Ex Hazard Array

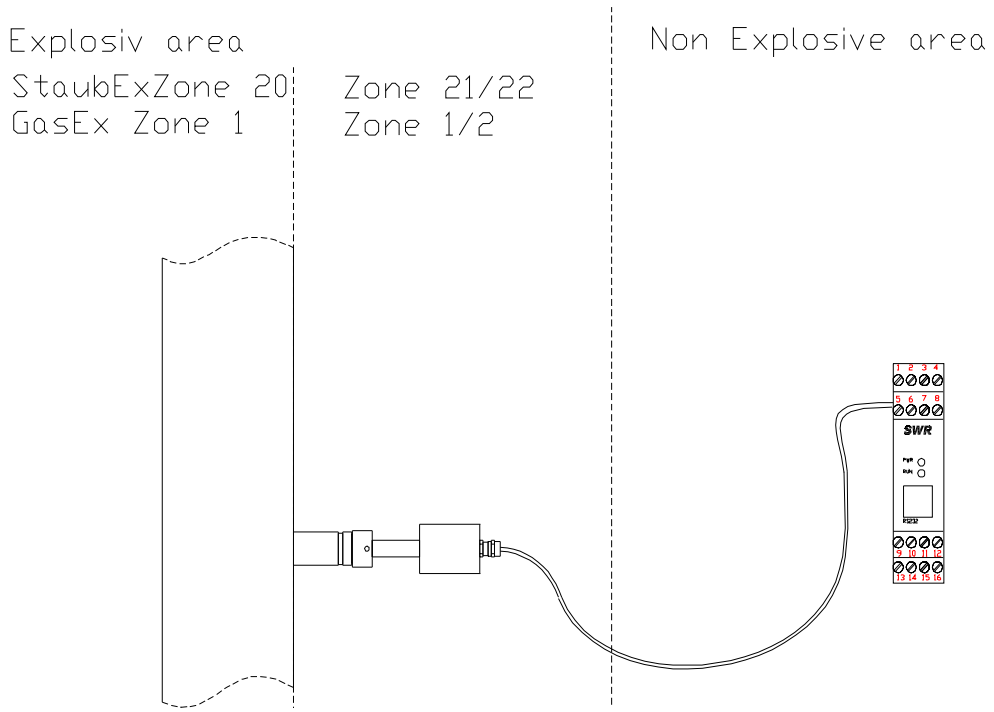
Marking Dust Ex: **ATEX II 1/2D IP 65 T84°C**

- Group of equipment 2
- Equipment category: 1/2
  Waveguide window zone 20 / Housing zone 21
- For combustible mixtures from air and inflammable type of dust
- IP-Code 65
- Maximum surface temperature 84°C with Ta = 60°C

Marking Gas Ex: **ATEX II 1/2D IP65 T84°C**
II 2G EEx d IIC T3

- Group of equipment 2
- Equipment category 2
- Zone 1
- For combustible mixtures from air and inflammable type of gas
- IP-Code 65
- Maximum surface temperature 84°C with Ta= 60°C

“Explosive area” **“Non-explosive area”**



3.7 Electrical Connection

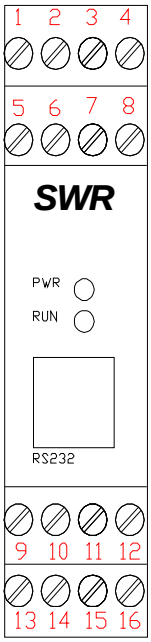


Fig. 10: Electrical Connection

Transmitter unit			
Terminal		**Connection**	
Supply voltage			
4		Input supply voltage +24 V / DC	
3		Input supply voltage 0 V / DC	
Connections			
I/U-out	**2**	Current output + 4..20mA	
	1	Current output - 4..20mA	
Relay	**8**	Potential free N.O. (make contact)	
	7	Potential free COM (contact)	
	6	Potential free N.C. (open contact)	
Modbus	**11**	RS 485 interface data B	
	12	RS 485 interface data A	
Sensor	**16**	Supply voltage +24V	Cable no. **1**
	15	Supply voltage 0V	Cable no. **2**
	14	RS 485 data A	Cable no. **3**
	13	RS 485 Data B	Cable no. **4**

4 Commissioning

For start-up the measurement system it is necessary to adjust the sensor to the local conditions. After switching on the power supply there is at least a warm-up time about 15 minutes required before any adjustment starts.

Please check again :

- The correct cabling between sensor and the evaluation unit
- The correct adjustment of the wall thickness at the sensor.

In case that despite these steps a successful measurement is impossible, please contact SWR.

Commissioning of SolidFlow

For start-up the sensor ***has to be calibrated and parameterized to each product***, which will be measured. It is necessary to assign the mass flow to the display and initial value. The menu functions are mostly self-explaining.

Put in the installation CD in the PC or Laptop and follow the installation menu. The program is running with the operation systems Windows 98, NT and XP. The connection is possible by using the RS323C-interface (slot in the front plate), or by using the integrated RS485-interface (bus capable) at the spring clips 11 and 12. By using different addresses for each transmitter unit, the measurement units can be identified and operated separately and remotely over the Modbus protocol.

Following a short introduction to the overview:

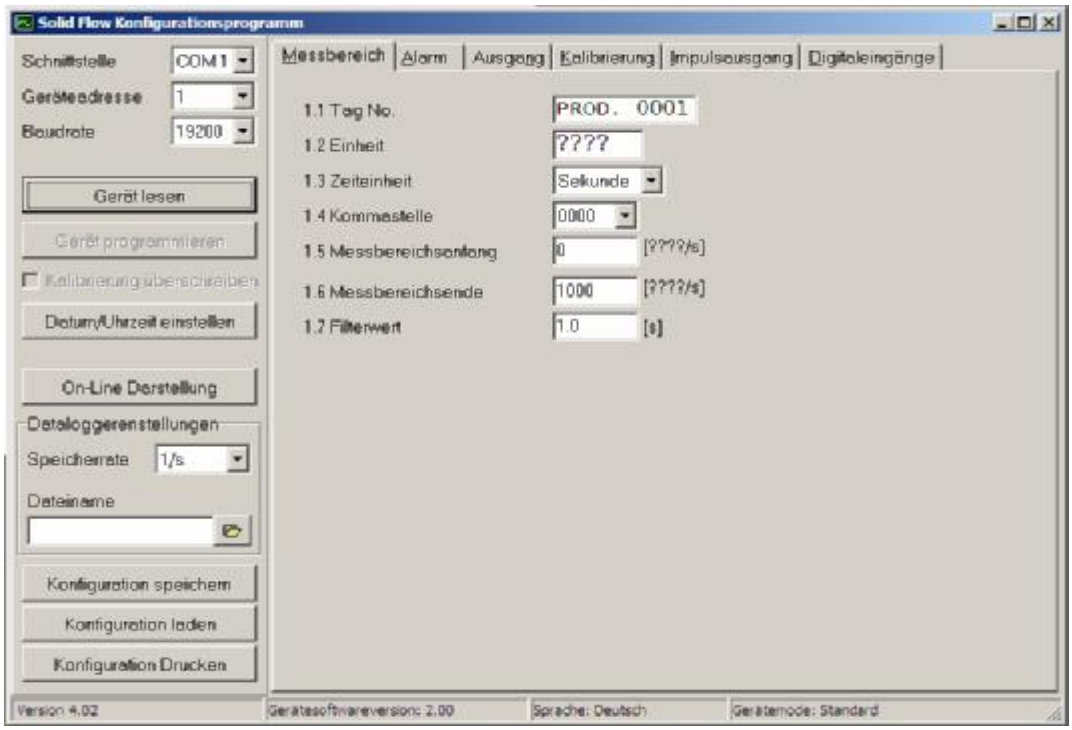
All changed values have to be confirmed by leaving the menu level and by confirming the storage function.

Starting the Menu		After the start of the configuration program the interfaces COM 1 until COM 8 (at the PC/Laptop display) have to be chosen. The baud rate has to be set at 9600bd. Set the transmitter unit address (std. is 1).
Basic Function		It is sufficient to carry out a two-point-calibration (normally min and max). Enter the data in menu 4.2.
	Min-Point	Set point 1 to 0, when the mass flow is shut down and calibrate this point.
	Max-Point	Set point 2 to known maximum flow rate with normal conveying and calibrate as well. (This value can be adjusted later on.) Thus the basic function of the measuring system is given and it is now ready for operation.
Adjustment		See menu 1, point 1 to 3 for the adjustments to the individual local conditions regarding material, measuring units, etc.
	Current / Voltage-	The initial values are defined in the menu points 1.5 and 1.6

Output	The output value (current/voltage) is assigned to the measuring range here. **à** Standard: 0 = 4mA Max = 20 mA The measuring range filter is used for the adjustment to slower working devices or for a continuous output of the analogue output.
Different Alarm types	They are set in menu 2.
Analogue Output	It is set in menu 3 and can be adjusted to the individual requirements (e.g. 0-20mA)
Auxiliary Points	The linearization can be examined by measuring the varying mass throughput. This should be weighed out in each single case for the improvement of the accuracy. If there are deviations the non-linearity can be corrected by a basic table. According to the chosen and fixed points in menu 4.2 (minimum 2 for the first start-up of the commissioning), it is now possible to enter a correction value for the actual mass flow. (This value can be changed afterwards)
Storage	When leaving the system you will be asked, if adjusted values should be stored or not. By pressing **ok** the adjustment is done, by pressing **n** it will be rejected.
C-Box	This connection box is only used, if the distance between the sensor and the evaluation unit exceeds 1.8 meters.

Following the menu parameters in detail :

5 Menu Structure of SolidFlow



1 Measuring Range

1.1	**Tag No**	Adjust Material (10 Digits)
1.2	**Unit**	Adjust text e.g. Kg
1.3	**Time Scale**	Choose: h / min / s (Reference time for the Pulse Output and Totalizer)
1.4	**Decimal Point**	Choose position of dec. point
1.5	**Beginning of Measuring Range**	Range 0 --- 999
1.6	**End of Measuring Range**	Range 0 --- 999
1.7	**Filter Value**	Range 0,1 --- 99,9 sec

2 Alarm

2.1.	**Type of Alarm**	Choose: MIN/MAX
2.2.	**Value of Alarm**	-10 to 110% in phys. Units
2.3.	**Alarm Dead Time**	Range 0,1 --- 99,9 sec
2.4.	**Alarm Hysteresis**	0,1 --- 99,9 %

2.5.	**Operation Mode**	Choose: Working- / Static Current Principle
2.6.	**Alarm Sensor Malfunction**	on / off

3 Analogue Output

3.1	**Beginning of Measuring Range**	Range: 0 --- 22 mA (Standard: 4mA)
3.2	**End of Measuring Range**	Range: 0 --- 22 mA (Standard: 20mA)
3.3	**MIN Point**	Range: 0 --- 22 mA (Standard: 3mA)
3.4	**MAX Point**	Range: 0 --- 22 mA (Standard: 20mA)
3.5	**Value of Alarm**	Range: 0 --- 22 mA (Standard: 3mA)
3.6	**Filter Time**	Range: 0,1 --- 99,9 sec (Standard: 1s)
3.7	**Calibration: 4 mA**	Adjust current output (4mA calibrated)
3.8	**Calibration: 20 mA**	Adjust current output (20mA calibrated)

4 Calibration

4.1	**Calibration Factor**	Range 0,01 --- 9,99
4.2	**Calibration Filter**	Range 0,1 --- 999,9 sec
4.3	**Number of Calibration Points**	Range 2 --- 20 Auxiliary Points
4.4	**Calibration**	

4.4.1	**Calibr. Point 1 Meas. Value**	Range of Beginning --- End of Measuring Value (in phys. units)
4.4.2	**Calibr. Point 1 Raw Value**	Adjust Initial value
	... (depending on the no. of calibration points)	
4.4.(2*N)	**Calibr. Point N Meas. Value**	Range of Beginning --- End of Measuring Value (in phys. units)
4.4.(2*N+1)	**Calibr. Point N Raw Value**	Adjust Initial Value

7 System

Baud rate	4800 / 9600 / 19200 / 38400
Modbus-Address	Range 1…255
Language	Choose: D / F / E

6 Menu parameters :

1. Measuring range

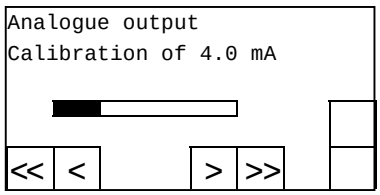
Tag no.	Freely selectable symbols of the measuring medium - or place, max. 10 digits.
Unit	Entry of the measuring range max. 6 digits.
Time scale	Choice of the time unit is important for the tantalizer; Choose between h / min / s /s per second /min per minute /h per hour
Decimal point	Adjust the digit in the display.
Measuring range (start)	Enter the respective value of the measuring range you will start with. (Usually 0.0)
Measuring range (end)	Enter the respective value of the measuring range end.
Filter value	Adjustable damping for the Display in seconds. Range : 0,1 ... 99,9 sec

2. Alarms

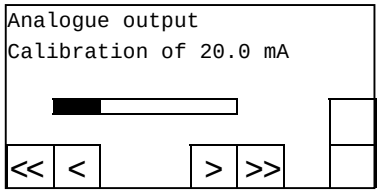
Alarm type	Upper and lower limit value
Alarm value	Threshold value Range: –10 ... 110 % of the measuring range in phys. units
Alarm dead time	Threshold value how long the value must be over or under the limit until the alarm relay reacts; Range: 0,1 ... 99,9 sec
Alarm hysteresis	Threshold value of the alarm Range : 0,1 ... 99,9% of the measuring range.
Operation mode	Choice of the contact work or interruption NO Working current NC Static current
Alarm Sensor (fault)	On / Off

3. Analogue output

Starting range	Value for the output min Range: 0 ... 22 mA (std: 4 mA)
End of range	Value for the output max. Range: 0 ... 22 mA (std: 20 mA)
MIN limit	Value for the MIN-Limit Range: 0 ... 22 mA (std: 3.0 mA)
MAX limit	Value for the MAX-Limit Range: 0 ... 22 mA (std: 20 mA)
Threshold value	Alarm value (sensor error or internal alarm) at the same time relay 3 is released Range: 0 ...22 mA (std: 3 mA)
Filter Time	Adjustable damping for the current output. Range: 0,1 ... 99,9 s (std: 1 s)
Trim: 4mA	Value of current min.; Adjust to the external measuring system (if display shows difference)

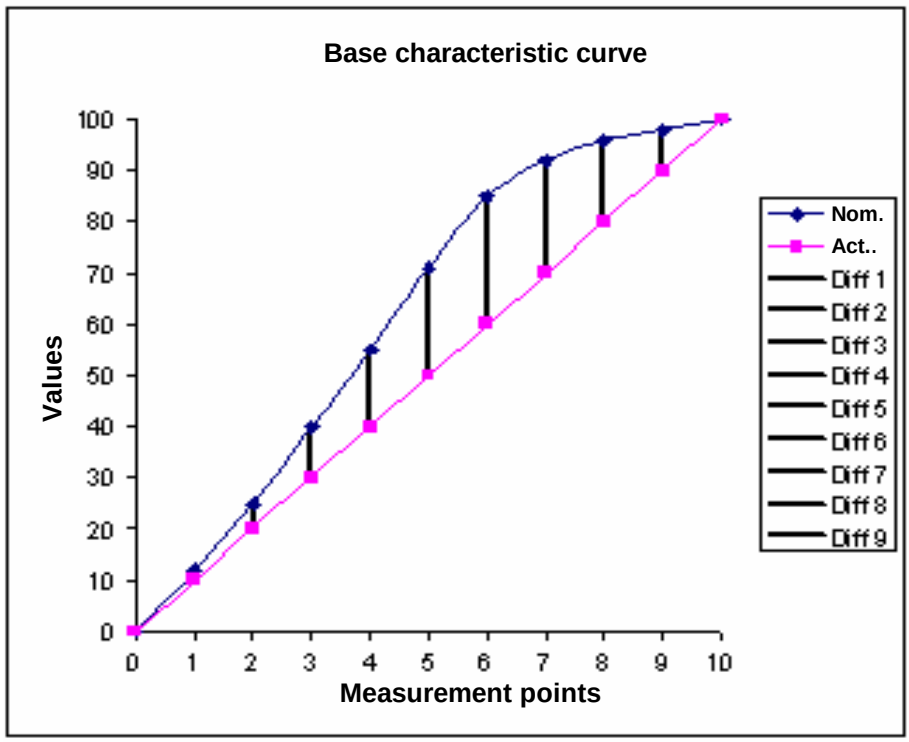


Trim: 20mA	Value of current max.; Adjust to the external measuring system (if display shows difference)



4. Calibration

It is only necessary if there is a disturbing nonlinearity (as you see in the diagram); The base points of the nominal characteristic curve (red colour) are set and are calibrated onto the actual characteristic curve (blue colour). The adjustment happens in the sensor and the value output is linear.



Calibration factor	Global calibration factor of the measuring on the display and as well the output range from 0,01 to 9,99 (std: 1,0)
Calibration filter	Damping filter for setting unsteady signals during the calibration. (no effect on output and display); 0,1 to 999,9 sec
Number of calibration points	Set the number of the auxiliary points
Calibration:	
Cal. Point 1 (measurement value)	Value measuring in phys. units Range : Start ...end.
Cal. Point 1 (raw value)	Indicate the initial value to the value displayed, if pressed [8]. With [C] leave the menu without any change.

All other points are calibrated as the first one.

5.	Impulse output	Function not available
6.	Digital input	Function not available
System		Adjusting of the Modbus intersection parameter in case of a connection to the system bus.
	Baud rate	Indicating of the baud rate 4800 / 9600 / 19200 / 38400
	Modbus address	Set 1 ... 255
	Language	Indicating of the Language Choose : D / F / E
	Storage	Only with change and leaving the menu level.

7 Maintenance

Warning!
Danger of shock with opened housing!

- Switch off the supply voltage for all maintenance or repair works on the measuring system. The tube must not be in operation during a sensor exchange.
- Repair and maintenance work must be carried out by trained or expert personnel only.
- The system is maintenance-free.

8 Warranty

Warranty is granted for one year starting from delivery date under the condition that the operational instructions have been followed, no interventions on the appliances have been made and the components of the system show no mechanical damage or wear resistance.

In case of a defect during the warranty period, defective components are repaired or are replaced free of charge. Replaced parts turn into the property of SWR. If desired by the customer that the parts should be repaired or replaced in his factory, then the customer has to take over the costs for the SWR-service staff.

SWR is not responsible for damage, which did not develop at the delivery article; especially SWR is not responsible for escaped profit or other financial damages of the customer.

9 Trouble shooting

Warning!
The electrical installation must only be checked by expert personnel.

Problem	**Cause**	**Measure**
Measuring system does not work. POW LED off RUN LED off	Power supply interrupted.	Check the power supply.
	Break of a cable.	Check the connecting cables for a possible break of a cable.
	Fuse defective.	Exchange the fuse in the field housing.
	Device defective.	Contact SWR.
Measuring system outputs wrong values POW LED on RUN LED slow flashing	Calibration not correct.	Delete input signal correction, new calibration according to section 6.
	Calibration shifted by abrasion on front end of sensor.	Delete input signal correction, new calibration according to section 6.
Sensor malfunction POW LED on RUN LED fast flashing	Sensor not properly connected	Check cable
	Sensor damaged	Replace sensor
	No 24 Volt supply on Sensor	Assure power supply
	Voltage drop on the supply line too highly.	Examine cable lengths on the basis of the table in chapter 3.5 (page 9).
Relay flickering	Hysteresis too small.	Increase hysteresis, check effects caused by external devices.

Do not open, as otherwise the warranty claim expires!

10 Technical Data

Sensor/Sensor accommodation	
Housing	Stainless steel 1.4541 (option: Steel St52, galvanised)
Protection category	IP65; ATEX: cat. 1/2 GD (option)
Operating temperature	Front end of sensor: optional: -20...+200 °C [-4...392°F] sensor electronic: 0....+ 60 °C [32...140 °F]
max. working pressure	1 bar, optional 10 bar
Working frequency	K-Band 24.125 GHz, ±100 MHz
Transmitting power	Max. 5 mW
Weight	Approx. 1.3 kg
Dimension	∅ 60, Ø 20, L 290mm
Accuracy	+/- 2..5% in calibrated range
Evaluation-Unit	
Supply voltage	24 VDC +/- 10%
Power consumption	20 W, 24 VA
Protection category	IP40 to EN 60 529
Operating temperature	–10...+45 °C [14...113 °F]
Enclosure dimensions	22,5 x 90 x 118,8 mm (W x H x D)
Weight	approx. 350 g
Mounting type	DIN 60715 TH35
Current output signal	4...20 mA (0...20mA), Load < 500 Ω
Measurement value alarm relay output	Relay with switching contact Max. 250V AC, 1A
RS232 Interface	
RS485 Interface	ModBus Interface
Data storage	Flash

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